Surface Conditioning and Bonding Protocol for Nanocomposite Indirect Restorations: How and Why?

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Surface Conditioning and Bonding Protocol for Nanocomposite Indirect Restorations: How and Why?

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IAAD WORKING INSTRUCTIONS

Question: What is the best surface conditioning and bonding protocol for indirect restorations manufactured from nanocomposite-based CAD/CAM blocks?

Answer: Materials composed of ceramics and resin composite materials have been introduced for use in CAD/CAM technologies. Of these materials, machinable nanocomposite resin-based blocks are indicated for CAD/CAM-made indirect restorations and are claimed to represent a good alternative to brittle dental ceramics.[1] Such blocks consist of zirconia/silica particles (80 wt%) embedded in a highly cross-linked resin matrix (20 wt%) and are claimed to combine the positive aspects of both ceramics and resin composites.[8] Since they are less brittle, they present excellent machinability.[8] For the adhesive cementation of restorations made of so-called nanocomposite or resin nanoceramic materials, limited published material is available, apart from manufacturers' instructions. Thus, the following surface conditioning and bonding protocol could be recommended based on the available scientific reports:

Do	Why?
After adjusting and polishing, the indirect nanocomposite restoration should be ultrasonically cleaned in distilled water for at least 5 min.	Cleaning saliva and other contaminants from the cementation surface helps ensure adequate adhesion of the subsequent adhesive promoters to be applied on the surface.
Roughen the intaglio surface of the restoration using air abrasion with Al_2O_3 of particle size ≤ 50 µm or 30 µm SiO_2 at a pressure of 2 bar for a duration of 5 to 20 s, depending on the size of the surface area, until the surface turns matte. Make sure that the surfaces other than the cementation surface are coated with glycerine gel so that particles do not damage the polished areas.	Surface activation by air abrasion increases roughness and provides both micromechanical interlocking and chemical adhesion of the resin cement.[2] Both particle types presented similar adhesion results to this material.[3,6] Nanocomposite materials show slight resistance to hydrofluoric acid etching, without proper dissolution of the glass fillers.[3]
Clean the surface with alcohol and dry with oil free air.	Removal of particle residues is critical to achieve better wettability of the bonding agent. The use of alcohol is recommended by the manufacturer of Lava Ultimate.
Scrub the universal bonding agent on the cementation surface with a clean microbrush for 20 s. Do not photopolymerize. Dry with oil-free air for 5 s.	For nanocomposite materials, application of bonding agents yielded higher bond strength values than the use of self-adhesive cements only.[5]
Apply dual-polymerizing resin-based luting cement to the intaglio surface and position the restoration on the previously conditioned preparation. Remove the excess cement, maintaining the restoration in place.	Self-adhesive resin cements containing residual acidic monomers reacts with tertiary amines.[4] They are unable to react with the benzoyl peroxide, which is responsible for the polymerization process of this type of cement.[4]
Photopolymerize for 20 s from each direction.	Indirect restorations having a thickness of 3 mm or more lead to decreased conversion rate of the base resin cement. Extending the photopolymerization time should be considered, especially when light attenuation by the restoration is expected due to its thickness/shade/opacity.[7]

CAVE: Currently, the most commonly used nanocomposite-based CAD/CAM material is Lava Ultimate (3M ESPE, St Paul, MN, USA). Other similar products are expected to be introduced for dental reconstructions in the near future. This protocol is a combination of the manufacturer's instructions and the results of available literature. Clinicians should study the composition of such products and make sure that the main component is resin and not ceramic when they employ the above-mentioned protocol. Clinicians should also note that the available literature does not focus on aging of adhesive interfaces between resin cements and nanocomposite materials.

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REFERENCES

1. Awada A, Nathanson D. Mechanical properties of resin-ceramic CAD/CAM restorative materials. J Prosthet Dent 2015;114:583-593.
2. Blatz MB, Sadan A, Kern M. Resin-ceramic bonding: a review of the literature. J Prosthet Dent 2000;89:268-274.
3. Elsaka E. Bond strength of novel CAD/CAM restorative materials to self-adhesive resin cement: the effect of surface treatments. J Adhes Dent 2014;16:531-540.
4. Farina AP, Cecchin D, Garcia LF, Naves LZ, Pires de Souza FC. Bond strength of fibre glass and carbon fibre posts to the root canal walls using different resin cements. Aust Endod J 2011;37:44-50.
5. Fuentes MV, Ceballos L, Gonzales-Lopez S. Bond strength of self-adhesive resin cements to different treated indirect composites. Clin Oral Investig 2013;17:717-724.
6. Kassotakis EM, Stavridakis M, Bortolotto T, Ardu S, Krejci I. Evaluation of the effect of different surface treatments on luting CAD/CAM composite resin overlay workpieces. J Adhes Dent 2015;17:521-528.
7. Lührs AK, Pongprueksa P, De Munck J, Geurtsen W, Van Meerbeek B. Curing mode affects bond strength of adhesively luted composite CAD/CAM restorations to dentin. Dent Mater 2014;30:281-291.
8. Spitznagel FA, Horvath SD, Guess PC, Blatz MB. Resin Bond to indirect composite and new ceramic/polymer materials: a review of the literature. J Esthet Restor Dent 2014;26:382-393.